Non EUCLIDEAN GEOMETRY 300-A Spring Semester 2002

MATH 300-A Geometry 10:00 A.M. M,T, Θ, F

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ROOM Thompson 222

OFFICE HOURS 11:00 A.M. - Noon Monday, Tuesday, Thursday, and Friday
9:30 A.M. - 11:00 A.M. Wednesday

I am also happy to make appointments for meetings at other times. Feel free to contact me personally, by telephone or by electronic mail.

TEXTBOOK

Euclidean and Non-Euclidean Geometries, 3rd Edition, Greenberg, ©1993,
W.H. Freeman and Company
Science/Math majors should consider obtaining a scientific word processor.

COURSE CONTENT The formal prerequisite for this course is Calculus 122. This means you should be familiar with the basic methods and techniques for thinking about and solving mathematical problems. However, the actual topics covered in calculus will not occur in this course until chapters 7 and 9. Most of the semester will be spent following an axiomatic treatment of Euclidean and hyperbolic geometry and, time permitting, will finish with a brief overview of Felix Klein's transformational approach. The axiomatic approach is called 'synthetic' geometry while Klein's approach is currently referred to as 'modern' geometry.

Geometry is a proof-based course offered by the mathematics department and as such fulfills both the university's "Writing in the Discipline" and the department's contract major writing requirements. In fact, a large portion of this course will be devoted to determining, and putting into practice, what it means to 'prove' a mathematical statement. This means there will be at least as much focus on providing detailed explanations of **why** the mathematical tools work as on when, where and how to use them. Hence, in all of your work, you will provide clear justifications for each and every step of your written argument. Remember this when you are writing up your projects.

READING Developing an ability to read and understand a (relatively) technical piece of writing is a primary goal of this course. This skill is fundamental not only for those who wish a career in science but also for anyone who wishes to be an "educated" member of society. Hence, careful reading of the texts is an integral part of this course — especially since lectures will not be word-for-word reiterations of the material in the textbook. I recommend multiple readings of the material as we cover it since technical material is extremely difficult to grasp quickly.

HOMEWORK There will be a (large) collection of take-home problems almost every Friday. These problems will be grouped into two types:

1. Computational or straightforward problems, and
2. Less straightforward or more conceptual problems.

By the end of the semester you are to turn in at least 24 problems: 8 of the first and 16 of the second type. Problems assigned more than one and one-half weeks before an examination will be due the same day as the examination. Problems will be graded both for mathematical accuracy and clarity of exposition (see below for the basic guidelines for written mathematics). This includes, but is not limited to, using complete senetences and including specific justifications for each non-trivial step in the solution. If you clearly mark a submitted problem as a **draft**, then I will comment on both content and style and return the problem to you. You may then resubmit the problem for a grade.

However, I will accept no more than five (5) submitted problems in any week so there is an effective limit on how many problems you may submit as drafts.

Feel free to use (or not) any technology that you like (e.g., CABRI, Geometers Sketchpad, calculators, *Mathematica*, MATLAB, etc.). You may also work with others in solving these problems but there is to be no collaboration in the writing of the solutions. Moreover, you must cite each resource you use. This includes: technological tools, texts read, participants in discussions and anything else other than your own thoughts. Citations are to occur in the text proper (in-line) except for your list of discussants which should appear at the end of your paper. Do not use footnotes or endnotes except in exceptional circumstances. Remember, failure to include references is intellectual theft!

It is best to think of these take-home problems as officially assigned papers in which you completely explain your analysis of the problem. At the very least you should write these problems:

- Using complete sentences
- In the first person plural
- With accurate punctuation
- For an audience consisting of students not in this class but with an equivalent background
- In a clear, easy to follow expository style

Since most of you are either science or mathematics majors, you should use a word processor to write your papers. The equation editor in Microsoft Word is acceptable but there are numerous other options available. My own preference is *Scientific Notebook* since its native format for files is TEX(the standard format for publishing papers in mathematics and most hard science. Use double spacing and avoid fonts smaller than 12 points. If you prefer to work by hand, I expect your written work to be in ink.

TERM PAPER You are to turn in one paper based on one of our less straightforward type 2 problems. The paper should include an analysis, solution, and extension of the problem. It should also address the historical context of your results as well as how they fit into the conceptual structure of the course. The papers are to be written in the "Class Journal" format (see below) and will be published as articles in the "electronic journal" *Journal of Undergraduate Mathematics at Puget Sound* on the class web page. Good examples can be found at the journal's website. For example, math.ups.edu/ bryans/Current/Journal_Spring_1999/JEarly_232_S99.html

For more detail, see the *Journal of Undergraduate Mathematics at Puget Sound* "Guidelines for Authors" page at my website.

The *Journal of Undergraduate Mathematics at Puget Sound* basic guidelines are as follows. (But see the webpage for more detail.)

- No one may publish a result that has already been published or submitted unless the material is presented in a new or more interesting form.
- Topics must be cleared with the editor (me) by April 5.
- The paper must be submitted by April 17, 2002. To submit a paper to the journal, authors are to give three **typed** copies of their paper to the editor (me). (See the "Guidelines for Authors".)
- Upon submission, the editor will designate two referees for the paper and give them copies.
- The referees will have one week (until April 24, 2002) to read the paper for accuracy, clarity of exposition and appropriateness for the journal as outlined in the *Journal* Guidelines for Authors (see the class web page for details). They will return their copy of the paper and their suggestions to the author.

- The author will have one week (until May 1, 2002) to make appropriate changes and submit the entire file (the referees' two copies, referee suggestions and an electronic version of the final paper) to the editor.
- The editor will decide if the paper is right for the journal (a passing grade) and will either publish or reject it. If rejected, the author will have a brief period of time to edit and resubmit the paper.

The author will receive a grade for the paper itself and the referees will receive a grade for the quality of their comments.

EXAMINATIONS There will be two examinations during the course of the semester. Sufficient interest from the class can change examination dates or move the exams to a 2-hour, evening format. Otherwise the schedule is

Exam 1 March 1, 2002

Exam 2 April 12, 2002

Make-up examinations will be given only if you make arrangements prior to the examination.

Exams will be "open everything" and consist of problems that are similar to those on the take-home sheets.

FINAL EXAM The final examination will be comprehensive. It will be held in our classroom on

Thursday May 16, 2002; 4:00 P.M. - 6:00 P.M.

Please note this schedule and do **not** plan to leave town before the scheduled time for the final.

GRADING The different aspects of the course will be weighted according to the following:

Writing (Referees)	5%
Writing (Author)	10%
Quizzes	55%
Examinations	30%
TOTAL	100%

First Assignment (Due Friday) Find my university web page

(http://math.ups.edu/ → faculty → Bryan Smith)

and locate the *Journal of Undergraduate Mathematics at Puget Sound* "Guidelines for Authors" page. Then send an e-mail message to me at bryans@ups.edu indicating that you have an account, understand how to access the World Wide Web, and are aware of how to avoid mistakenly sending e-mail to Beverly Smith that is meant for Bryan Smith.

Goals

Non-Euclidean Geometry We will explore the 2000 year history and development of one of the most interesting ideas to arise in western civilization. Our approach will follow that of our author (Greenberg) who uses historical vignettes as motivation and the axiomatic method as the primary tool for understanding the basics of non-Euclidean Geometry.

Reading/Writing It is important that you read the text. In fact, developing the ability to read technical material with understanding is one of the primary goals of this course. Another is to fine-tune the ability to present written arguments clearly and gracefully. It is easier to do this in mathematics than most other disciplines since the standard practice is to explicitly justify every claim.

Proof Most of this course, either directly or indirectly, deals with the issue of "proof". In particular, you will learn what it means when a mathematician claims to have proven a fact and through your paper, you will explore other notions of proof. Our primary tools for the study of mathematical proof are exactly the same as those used by our author (Greenberg) in his presentation of non-Euclidean geometry: elementary formal logic and the axiomatic method.